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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/191,930 11/13/98 CHIANG

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EXAMINER

MM91/0904

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ART UNIT

PAPER NUMBER

2825

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Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trad marks

Office Action Summary	Application N . 09/191,930	Applicant(s) CHIANG ET AL.	
	Examiner Lex Malsawma	Art Unit 2825	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 May 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 17-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 17-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input checked="" type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities:

On page 14, line 10, Examiner suggest replacing “dielectric 406” with “dielectric 404”, since element 406 has been disclosed as a patterned masking layer.

Appropriate correction or clarification is requested.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

3. Claims 17 and 18, are rejected under 35 U.S.C. 102(e) as being anticipated by Usami (6,222,269).

Regarding Claim 17:

Usami discloses (in Figs. 2A-3C and cols. 5-7) a method of forming an interconnect structure, comprising:

forming a first layer 4 of a first dielectric material on a substrate;

patterning the first layer (Fig. 2B);

depositing conductive material 13 over the patterned first layer;

planarizing the conductive material such that a plurality of interconnect lines 3 are formed;

forming a mask layer 14 over the interconnect lines 3 and patterned first layer 4 (Fig. 3A);
patterning the mask layer 14 such that a first portion of the interconnect lines and patterned first layer are covered, and a second portion of the interconnect lines and patterned first layer are uncovered;

removing the dielectric material 4 from the uncovered portion (Fig. 3B);

removing the patterned mask layer 14; and

depositing a second layer 5 of a second dielectric material.

Therefore, the instant claim is anticipated by Usami.

Regarding Claim 18:

Usami discloses the first dielectric material 4 has a dielectric constant (e.g., $k = 4$) greater than the dielectric constant of the second dielectric material 5 (note col. 6, lines 2-9). Therefore, the instant claim is anticipated by Usami.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 19 and 23-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Usami (6,222,269).

Regarding Claim 19:

Usami anticipates the method of Claim 17 but lacks the first dielectric material 4 having a dielectric constant less than that of the second dielectric material 5. However, it is noted that Usami discloses the general conditions of the instant claim, and given Usami's disclosure, one of ordinary skill in the art would have readily recognized that Usami can be readily modified, if so desired, by forming layer 4 of a low-k material and forming layer 5 using silicon dioxide. Therefore, it would have been an obvious matter of design choice for one of ordinary skill in the art to modify Usami by interchanging materials for layers 4 and 5, since both layers (4 and 5) comprise well-known dielectric materials wherein processes for forming said well-known dielectric materials are also very well known.

Regarding Claim 23:

Usami disclose a method of forming an interconnect structure that can reduce (or prevent) parasitic capacitance and crosstalk (note col. 8, lines 14-20), the method comprising:

forming a plurality of conductive lines 3 (Fig. 4A) on an insulating substrate, the plurality of conductive lines 3 having a first dielectric 4 and a second dielectric 5 therebetween;

wherein the first dielectric 4 has a dielectric constant greater than that of the second dielectric 5 (note col. 6, line 2-9).

Usami **lacks** forming a second plurality of conductive lines, however, it is noted Usami discloses forming all conductive lines at the same time, and one of ordinary skill in the art would have readily recognized that the conductive lines 3 could be formed in 2 or more "pluralities" (or sections) instead of a single plurality (i.e., instead of forming all the lines simultaneously). In other words, forming all the conductive lines simultaneously could save considerable process

time and cost in comparison to forming a first and second plurality of lines, however, one could obviously choose to form the conductive lines in two or more separate sequences of steps.

Therefore, it would have been an obvious matter of design choice for one of ordinary skill in the art to modify Usami by forming the conductive lines in a first and second plurality instead of forming all the conductive lines simultaneously.

Regarding Claims 24:

Usami discloses a method of forming an interconnect structure comprising:

forming, on a substrate, a first plurality of interconnect lines 3 and a first intralayer dielectric 4 disposed between the first plurality of interconnect lines (Fig. 2D);

removing a portion of the first intralayer dielectric 4 (Fig. 3B); and

forming a second intralayer dielectric 5 on the substrate where the first intralayer dielectric was removed (Fig. 3C).

Usami **lacks** forming a second plurality of interconnect lines in the second interlayer dielectric, however, it is noted Usami discloses forming all conductive lines simultaneously, wherein a plurality of interconnect lines will exist within the second interlayer dielectric layer when said second interlayer dielectric layer is formed. The instant claim is similar to claim 23, therefore, with similar reasoning applied to Claim 23 above, the instant claim is held obvious over Usami, i.e., it would have been a matter of design choice to form the conductive lines in a first and second plurality instead of forming all the conductive lines simultaneously.

Regarding Claim 25:

Usami discloses a dielectric constant of the first intralayer dielectric 4 is different from that of the second intralayer dielectric 5 (note col. 6, line 2-9).

Regarding Claim 26:

In general, the instant claim contains limitations for forming interconnect lines by a damascene process, and although Usami lacks forming a second plurality of interconnect lines, the instant claim is held obvious over Usami because of the following reasons: (1) Usami discloses a damascene process, in Figs. 2A-2D, wherein the plurality of conductive lines 3 are formed by etching trenches in the first intralayer dielectric 4, depositing a conductive material 13, and polishing the conductive material such that the conductive material is substantially removed except for that which is in the trenches; (2) Usami disclose forming all conductive lines simultaneously using a single damascene process instead of, for example, forming the conductive lines utilizing two separate damascene processes; (3) one of ordinary skill in the art would have readily recognized that Usami could be modified, if so desired, by forming several “pluralities” of conductive lines utilizing two or more damascene processes; therefore, if one chooses to form the conductive lines in several “pluralities” (i.e., in a first and second plurality of lines), then it would have been obvious to utilized the process steps in “(1)” when forming each of said several “pluralities” of conductive lines.

Regarding Claim 27:

Usami discloses a method of forming an interconnect structure comprising:

- (a) forming a first dielectric layer 4 on a substrate;
- (b) forming a plurality of interconnect lines 3 in the first dielectric layer 4 (Fig. 2D);
- (c) removing a portion of the first dielectric layer 4 (Fig. 3B); and

(d) forming a second dielectric layer 5 on the substrate where the portion of the first dielectric layer was removed, wherein the plurality of interconnect lines 3 are positioned in the first and second dielectric layers.

Usami lacks performing step “(b)” after step “(d)”, in other words, Usami lacks forming a plurality of interconnect lines simultaneously in the first and second dielectric layers. It is noted Usami discloses (in general) the inventive aspect of Applicants disclosure, i.e., Usami discloses forming an interconnect structure comprising two different dielectric layers formed between a plurality of interconnect lines such that the dielectric layers and the interconnect lines are on the same level of metallization, wherein the incorporation of two different dielectric layers can prevent crosstalk and reduce parasitic capacitance. Although the instant claim recites a different sequence than that disclosed by Usami (for acquiring an interconnect structure), the instant claim is held obvious over Usami because of the following reasons: (1) Usami discloses the general conditions of the instant claim; (2) the instant claimed process sequence may require more processing steps than Usami’s disclosed sequence, i.e., the first dielectric will need to be etched twice in both sequences, however, in the instant claimed sequence, it may not be possible to simultaneously etch openings in both dielectric layers using the same mask or etching chemistry, since the dielectric layers would be formed of different materials; (3) given Usami’s disclosure, one of ordinary skill in the art would have readily recognized that forming all the interconnecting lines after forming the second dielectric layer would be a matter of design choice, since such a choice would not reduce the number of process steps; therefore, it would have been an obvious matter of design choice for one of ordinary skill in the art to modify Usami by performing step

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performing step “(b)” after step “(d)”, since there seems to be no significant benefit for choosing such a modification.

Regarding Claim 28:

Usami discloses the dielectric constant of the first dielectric is different than that of the second dielectric.

Regarding Claim 29:

The instant claim, similar to Claim 26, contains limitations for forming the interconnect lines using a damascene process. With similar reasoning applied to claim 26 above, the instant claim is held obvious over Usami, i.e., a damascene process as instantly claim was well known and used in the art.

6. Claims 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Usami (6,222,269) in view of Cho (5,512,775).

Regarding Claims 20 and 21:

The instant claims are similar to Claims 17 and 18 except for the following: In the instant claims, the first layer of a conductive material is formed and patterned into interconnect lines, followed by depositing a first dielectric material over and between the interconnect line; and in Claims 17 and 18, the first dielectric is formed and patterned, followed by depositing a conductive material over and between the patterned dielectric layer. It is noted Usami anticipates Claims 17 and 18, therefore, limitations that have been addressed above, in reference to Claims 17 and 18, will not be specifically addressed in regards to the instant claims. In general, Usami discloses all limitations of the instant claim but **lacks** forming interconnect lines

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3 (note Fig. 2D of Usami) before forming the first dielectric material 4. Cho is cited only to show that it was very well known in the art to form and pattern a conductive material 12 (i.e., to form interconnect lines) before forming a dielectric layer 20 above and between the interconnect lines 12 (note Figs. 1A and 1D). One of ordinary skill in the art would have readily recognized that the interconnect lines 3 of Usami could have been formed before or after forming the first dielectric layer 4, since either method was very well known in the art. Therefore, the instant claims are held obvious over the cited references because one of ordinary skill in the art would have found it to be an obvious matter of design choice to modify Usami by forming the interconnect lines 3 before forming the first dielectric material 4.

Regarding Claim 22:

The instant claim is similar to Claim 19, therefore, it is held obvious over the cited references with similar reasoning applied to Claim 19 above.

Status of Claims

7. Claims 1-16 have been canceled.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Tsu (5,432,128), Jeng (5,486,493), and Zhao (6,071,809) are cited to show methods of forming conductive lines utilizing different dielectrics.

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Findley (6,243,653) is cited to show interconnect structures with different dielectrics between adjacent conducting lines.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lex Malsawma whose telephone number is (703) 306-5986.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (703) 308-1323. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 305-3431 for regular communications and (703) 305-3431 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Lex Malsawma



August 23, 2001



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